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EFFECTS OF DIFFERENT GRASSES ON PONDEROSA PINE SEEDLING ESTABLISHMENT

By

Frank J. Baron

ABSTRACT: Ponderosa pine and eight grass species were planted together on a burned area. Less than half the pines were dead after 3 years, whether in grass areas or not. When pine was planted in year-old grass, 80 percent died. Of pines planted without grass, only 30 percent died. Grass species differed in their effect on tree survival.

In September 1957, several thousand acres of old brush, growing on sites formerly covered by pine stands, were severely burned in Siskiyou County. The intense fire consumed all the aerial parts of the vegetation and most organic matter in the topsoil. Since both timber production and grazing are important in the area, rehabilitation was planned to restore both, and to reduce the threat of erosion. An experiment was designed to test various combinations of planting trees and tree seeds among each of eight species of grass.

In April 1958 the grasses were all sown individually on 240 plots (33 feet x 66 feet):

Big bluegrass.....*Poa ampla*
Hard fescue.....*Festuca ovina duriuscula*
Pubescent wheatgrass.....*Agropyron trichophorum*
Redtop.....*Agrostis alba*
Orchard grass.....*Dactylis glomerata*
Perennial ryegrass.....*Lolium perenne*
Tall oatgrass.....*Arrhenatherum elatius*
Timothy.....*Phleum pratense*
Control, no grass, native vegetation only

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Thirty additional plots, not sown with grass, served as controls. In each of 3 years, beginning in 1958, 2-year-old ponderosa pines from the Mt. Shasta nursery were planted on 45 of the plots, and ponderosa pine seeds, stratified and treated with endrin-arasan repellent, were spot-seeded on 45 additional plots. Survival of the pines growing among each of the grass species was compared to control plots, free of all grass.

Brush plants resprouted profusely from root crowns over the whole area after the fire. Estimated proportions of the major species were: snowbrush 40 percent, willow 20 percent, bitter cherry 20 percent, and chinkapin 20 percent. Consequently, 1959 and 1960 pine plantings were made on split plots, and 2,4-D was sprayed on brush plants in one of each pair of subplots. Back-pack pumps were used to apply approximately 4 pounds per acre of 2,4-D (low-volatile ester in oil-water emulsion) during mid-June of 1959 and 1960.

Results

When grass and ponderosa pine were started simultaneously, 3-year survival of pine averaged 50 percent on all grass plots and 63 percent on control plots (table 1). Pines planted without grass had better survival than those planted with either orchardgrass, oatgrass, ryegrass, or timothy (Group A); however, in plots sown to bluegrass, wheatgrass, fescue, or redtop (Group B), pine survival was better than in the controls. Direct-seeded pine also showed a difference in survival between grass plots after 3 years but had higher levels of stocking in control plots than in any of the grass plots. In fact, the seeded controls exceeded the planted controls.

Among trees started in 1959, when the grass was 1 year old, planted pines survived much better than seedlings from seed-spots, The presence of grass also was more critical. Mortality was high during the first growing season, but fewer trees died in the control plots than in the grass plots (table 2).

When pine planting was deferred until grass was 2 years old (1960), survival was extremely poor for both pine seedlings and transplants. Planted trees in the control plots survived significantly better than trees in any of the plots with grass. The pine seed-spots were almost complete failures except in the control plots. No significant differences were noted among the survival rates of pine growing among the various species of grass.

Changes in survival relationships are especially noticeable in the direct-seeded plots of 1958 containing grasses of Group A (table 2). After the first growing season, tree survival in these plots averaged better than in the controls, but later mortality reversed the relationship. Thus, the timing of survival tallies can be critical in evaluating either planting or seeding.

Trees planted in control plots, or with grasses of Group A, showed higher survival where brush was sprayed with 2,4-D than where unsprayed (table 3 and fig. 1). Group B grass plots had higher tree survival in unsprayed areas. Possibly, defoliation of brush by the herbicide reduced shading and allowed more vigorous grass development in these plots. Data on herbicide effects are less extensive than expected because of high tree mortality and failure of seedspots in 1959 and 1960, when precipitation and soil moisture were much below normal. Extremely hot weather during May and June 1960 placed additional stress on the plants.

All grass species appeared to develop well in spite of the dry, hot weather, but no critical evaluation of the grass stands was made.

Discussion

One reason for differences in pine survival among the grass species may be selectivity in grazing by cattle on the study area. Oatgrass and orchardgrass were hardly touched; adjacent bluegrass and wheatgrass appeared severely cropped. Heavier grazing of grasses would tend to lessen depletion of soil moisture. Cattle grazing apparently did not cause serious damage to pines, but some were injured by trampling, smothering with droppings, or accidental cropping along with grass tufts.

Deer, rabbits, and mice apparently increased in numbers on the study area as years went by, so damaging the conifers that data on tree height-growth are meaningless. The "open winters" of 1958-59 and 1959-60 permitted extensive use by deer, as indicated by tracks, bedding grounds, and severely browsed pines. Rabbits clipped the pine seedlings and were especially numerous in 1960, when their droppings littered the area. Many mice were seen about the grass-covered areas. Empty pine seed coats were abundant around the pine seedspots; apparently mice ate the seeds without ingesting the endrin coating, for no dead mice were found.

In this study the effect of grass on pine regeneration depended on the species of grass, as well as on the age of the grass stand when the pines were planted. Weather irregularities, competing native vegetation, and animal activity also affected the results. As a sidelight, the effectiveness of complete site preparation was suggested by an administrative study 100 feet away. An acre of mechanically cleared land, seedspotted at the same time as the 1960 tests, had 50 percent stocking in the fall and little evidence of rodent-caused damage.

Summary and Conclusions

On a hard burn, ponderosa pines were established successfully when planted or direct-seeded simultaneously with grass sown the first year after the burn. New pine plantings in the second and third years after fire were progressively poorer, and seedspots failed. Low precipitation during the second and third years probably contributed to poor

survival of trees, and an apparent rise in the rodent population resulted in great losses in direct-seeding tests. The general trend, however, was consistent: plantability declined rapidly after fire.

In the first-year plantings, pine establishment was not seriously impeded by four species of grass (bluegrass, wheatgrass, redtop, and fescue) but was impeded by four other species (oatgrass, rye, timothy, and orchardgrass). In second- and third-year tree plantings, the harmful effects of grasses (presumably competition for soil moisture) became more apparent for all grass species. Tree survival was somewhat better where native brush regrowth was sprayed with 2,4-D, but not as good as on plots planted immediately after the fire.

Table 1.--Tree survival and seed-spot stocking, October 8, 1960, by grass species and year of pine planting

(Averages of 5 blocks)

Grass species	1958 planting			1959 planting			1960 planting		
	Planted trees	Seed-spots	All	Planted trees	Seed-spots	All	Planted trees	Seed-spots	All
	Percent[1]								
Group A									
Big bluegrass	63	61	62	36	0	18	10	0	5
Hard fescue	67	48	58	28	1	14	7	0	3
Pubescent wheatgrass	68	47	58	18	1	10	1	0	1
Redtop	66	49	58	22	0	11	4	0	2
Average	66	51	59	27	1	14	6	0	3
Group B									
Tall oatgrass	47	35	41	12	0	6	6	0	3
Timothy	39	52	45	16	0	8	1	1	1
Perennial ryegrass	50	44	47	18	0	9	16	2	9
Orchardgrass	39	29	34	14	0	7	5	1	3
Average	44	40	42	15	0	8	7	1	4
Average, all grasses	55	45	50	21	1	11	6	1	3
Control (no grass)	57	69	63	68	14	41	26	8	17
Yearly averages	60	55	52	25	2	14	8	1	5

1/ The following differences between treatments were significant (5 percent level):

1958 = 7 percent
1959 = 4 percent
1960 = 10 percent.

Table 2.--Cumulative mortality[1/] during three growing seasons, by year of pine planting and time after planting

(Averages of 5 blocks)

Time after planting	1958 planting			1959 planting			1960 planting		
	Control [2/]	Group A [3/]	Group B [4/]	Control [2/]	Group A [3/]	Group B [4/]	Control [2/]	Group A [3/]	Group B [4/]
	Percent								
Planted trees									
2 months	7	2	9	2	14	25	59	61	62
6 months	39	20	38	27	71	81	74	94	93
18 months	40	32	54	32	73	85	--	--	--
30 months	42	34	56	--	--	--	--	--	--
Seed-spots									
2 months	12	10	13	27	77	84	86	94	89
6 months	21	19	30	73	99	100	92	100	99
18 months	28	40	51	86	99	100	--	--	--
30 months	31	49	60	--	--	--	--	--	--

1/ Mortality in percent of original number of trees or seedspots.
2/ Native vegetation only.
3/ Bluegrass, fescue, wheatgrass, and redtop.
4/ Oatgrass, timothy, ryegrass, and orchardgrass.

Table 3.--Effect of brush control and grass upon planted tree survival and seed-spot stocking after one growing season (1959 planting)

(Averages of 5 blocks)

Item	Brush treatment	Control[1]	Group A[2]	Group B[3]
		Percent[4]		
Planted trees	Unsprayed	31	12	13
	Sprayed with 2,4-D	42	17	7
Seed-spots	Unsprayed	10	0	0
	Sprayed with 2,4-D	18	1	0

1/ Native vegetation only.
2/ Bluegrass, fescue, wheatgrass, and redtop.
3/ Oatgrass, timothy, ryegrass, and orchardgrass.
4/ A difference of 9 percent between treatments is significant (5 percent level).

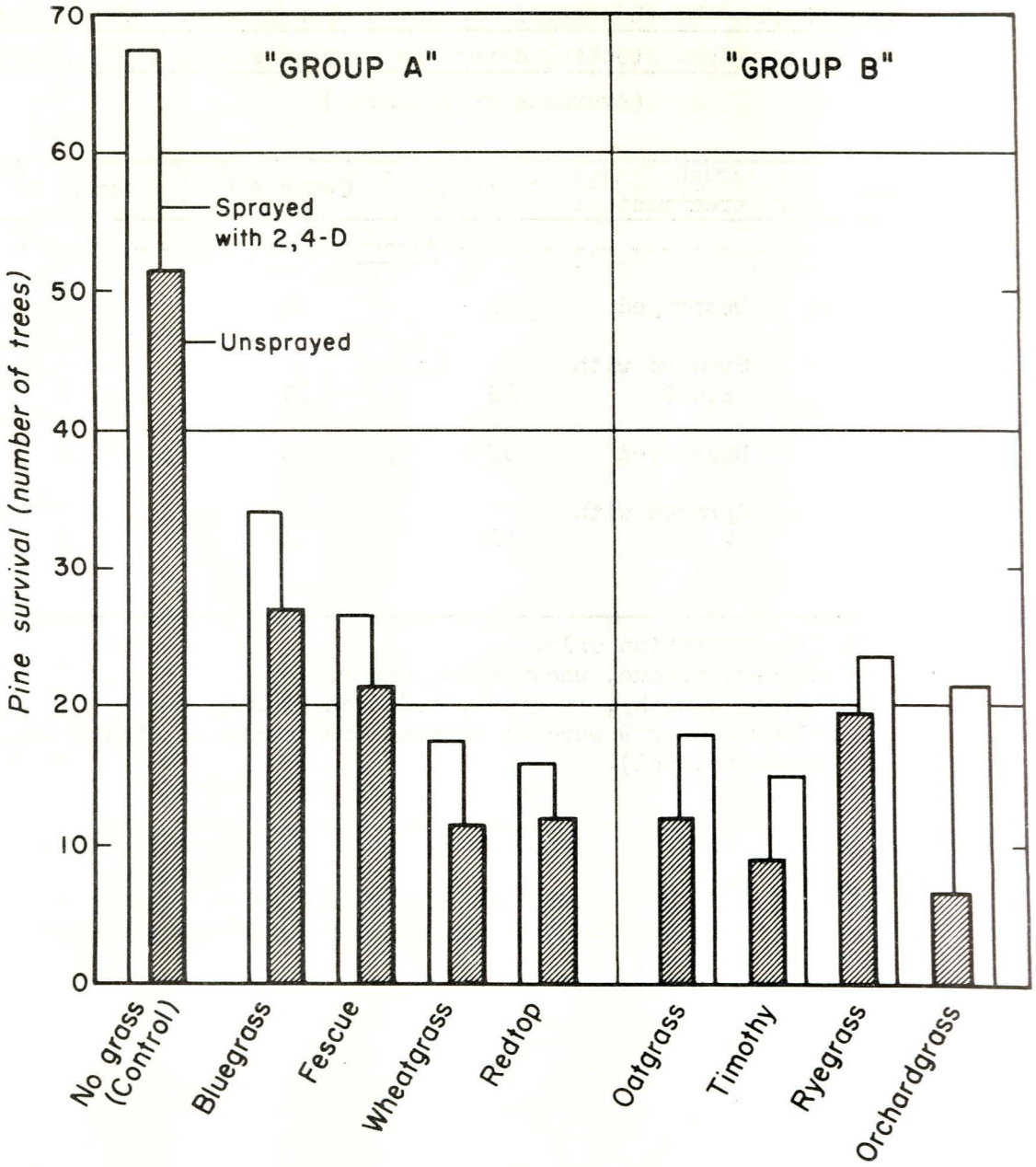

Figure 1.--Brush-spray effect on first-year survival of trees planted in plots sown to various grasses. (Combined data 1959 and 1960 plantings.